

IN THE CLAIMS

Please amend the claims as indicated:

- 1 1. (previously presented) An apparatus for use on a bottom hole assembly (BHA) for
2 conveying in a borehole in an earth formation, the apparatus comprising:
3 (a) an orientation sensor making measurements indicative of a toolface angle
4 of said BHA during rotation of the BHA;
5 (b) at least one directionally sensitive formation evaluation sensor for making
6 measurements of a property of said earth formation during said continued
7 rotation; and
8 (c) a processor which estimates from said directionally sensitive
9 measurements and said orientation sensor measurements a local spatial
10 characteristic of said earth formation
11 wherein said BHA has a non-uniform rate of rotation.
12
- 1 2. (previously presented) The apparatus of claim 1 wherein said local spatial
2 characteristic comprises a dip of a bed boundary.
3
- 1 3. (previously presented) The apparatus of claim 1 wherein said local spatial
2 characteristic comprises a dip of an oil-water contact.
3
- 1 4. (previously presented) The apparatus of claim 1 wherein said at least one

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- 2 directionally sensitive formation evaluation sensor comprises two directionally
3 sensitive formation evaluation sensors spaced apart along an axial direction of
4 said BHA..
5
- 1 5. (previously presented) The apparatus of claim 1 wherein the at least one
2 directionally sensitive formation evaluation sensor comprises a galvanic
3 resistivity sensor.
4
- 1 6. (original) The apparatus of claim 5 wherein said galvanic sensor comprises a
2 focused sensor.
3
- 1 7. (previously presented) The apparatus of claim 1 wherein said at least one
2 directionally sensitive formation evaluation sensor comprises an induction sensor.
3
- 1 8. (original) The apparatus of claim 7 wherein said induction sensor comprises a
2 sensor having a coil with an axis inclined to an axis of said BHA..
3
- 1 9. (previously presented) The apparatus of claim 1 wherein said at least one
2 directionally sensitive formation evaluation sensor comprises a resistivity sensor
3 having a plurality of transmitter-receiver spacings and further comprises circuitry
4 for measuring at least one of (i) an amplitude difference, and, (ii) a phase

5 difference of signals measured at said plurality of spacings.

6

1 10. (original) The apparatus of claim 1 wherein said orientation sensor is associated
2 with a first processor and said at least one resistivity sensor is associated with a
3 second processor, said first and second processors being on a common bus.

4

1 11. (previously presented) The apparatus of claim 1 wherein said orientation sensor
2 comprises at least one of (i) a magnetometer, (ii) an accelerometer, and, (iii) a
3 gyroscope.

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1 12. **canceled**

2

1 13. (previously presented) The apparatus of claim 1 further comprising a sensor for
2 providing a measurement indicative of an inclination and azimuth of said
3 borehole.

4

1 14. (original) The apparatus of claim 1 wherein said processor further determines a
2 bias in said orientation measurements.

3

1 15. (canceled)

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- 1 16. (previously presented) The apparatus of claim 1 wherein said at least one
2 directionally sensitive formation evaluation comprises a resistivity sensor is
3 mounted on one of (i) a pad, (ii) a rib, and, (iii) a stabilizer.
4
- 1 17. (previously presented) The apparatus of claim 1 wherein said processor further
2 constructs and corrects an image of said borehole.
3
- 1 18. (currently amended) The apparatus of claim 1 wherein ~~a processor~~ said processor
2 further controls a drilling direction of said borehole based on said local spatial
3 characteristic of said earth formation.
4
- 1 19. (currently amended) The apparatus of claim 1 wherein said processor determines
2 said local spatial characteristic of said earth formation based on an apparent rate
3 of penetration of the BHA.
4
- 1 20. (currently amended) A method of estimating a local spatial characteristic of an
2 earth formation, the method comprising:
3 (a) conveying a bottom hole assembly (BHA) into a borehole in an earth
4 formation;
5 (b) using an orientation sensor on said BHA for making measurements
6 indicative of a toolface angle of said BHA during continued rotation of the

7 BHA;

8 (c) using a first directionally sensitive formation valuation sensor on said

9 BHA for making measurements indicative of of said local spatial

10 characteristic of said earth formation during said continued rotation; and

11 (d) estimating the local spatial characteristic of the earth formation from using

12 said measurements of said directionally sensitive formation evaluation

13 sensor and said orientation sensor measurements ~~said local spatial~~

14 ~~characteristic of said earth formation~~, said estimation correcting for a non-

15 uniform rate of rotation of said BHA.

16

1 21. (previously presented) The method of claim 20 further comprising using said

2 determined local spatial characteristic for controlling a drilling direction of

3 said borehole.

4

1 22. (previously presented) The method of claim 20 wherein said local spatial

2 characteristic comprises a apparent dip angle between an axis of said borehole and

3 a bed boundary in said earth formation.

4

1 23. (currently amended) The method of claim 20 wherein determining said ~~dip~~

2 local characteristic further comprises using measurements from a second

3 directionally sensitive formation evaluation sensor spaced apart axially from said

4 first directionally sensitive formation evaluation sensor.

5

1 24. (previously presented) The method of claim 20 wherein the first directionally
2 sensitive formation evaluation sensor comprises a galvanic sensor.

3

1 25. (original) The method of claim 24 wherein said galvanic sensor comprises a
2 focused sensor.

3

1 26. (previously presented) The method of claim 20 wherein said first directionally
2 sensitive formation evaluation sensor comprises an induction sensor.

3

1 27. (previously presented) The method of claim 26 wherein said induction sensor
2 comprises a sensor having a coil with an axis inclined to an axis of said BHA.

3

1 28. (currently amended) The method of claim 20 wherein said first directionally
2 sensitive formation evaluation sensor comprises a resistivity sensor with a
3 plurality of transmitter-receiver spacings, and using said resistivity sensor further
4 comprises ~~a making~~ making measurements of at least one of (i) and amplitude
5 difference, and, (ii) a phase difference of signals measured at said plurality of
6 spacings.

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1 29. (previously presented) The method of claim 20 further comprising coupling a first
2 processor associated with said orientation sensor and a second processor
3 associated with the first directionally sensitive formation evaluation sensor to a
4 common bus.

1 30. (previously presented) The method of claim 20 wherein said orientation sensor
2 is selected from the group consisting of: (i) a magnetometer, (ii) an
3 accelerometer, and, (iii) a gyroscope..

1 31. **canceled**

1 32. (previously presented) The method of claim 20 further comprising using an
2 additional sensor for providing a measurement indicative of an inclination and
3 azimuth of said borehole.

1 33. (original) The method of claim 20 further comprising determining a bias in said
2 orientation measurements.

1 34. **canceled**

1 35. (previously presented) The method claim 20 wherein said first directionally

2 sensitive formation evaluation sensor is mounted on one of (i) a pad, (ii) a rib,
3 and, (iii) a stabilizer.

4

1 36. (original) The method of claim 20 further comprising obtaining an image of said
2 borehole.

3

1 37. (original) The method of claim 36 further comprising correcting said image.

2

1 38. (original) The method of claim 36 further comprising identifying tool face angles
2 associated with a sticking of the BHA.

3

1 39. (previously presented) The apparatus of claim 1 wherein said directionally
2 sensitive formation evaluation sensor is selected from the group consisting of (i)
3 a resistivity sensor, and, (ii) a nuclear sensor.

4

1 40. (previously presented) The apparatus of claim 1 wherein said local spatial
2 characteristic of said earth formation is selected from the group consisting of (i)
3 a dip of an interface in said earth formation, and, (ii) an image of a wall of said
4 borehole.

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1 41. (previously presented) The apparatus of claim 4 further comprising a processor

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2 for determining from measurements made by said two directionally sensitive
3 formation evaluation sensors a rate of penetration of said BHA.

4

1 42. (previously presented) The apparatus of claim 13 wherein said sensor for
2 providing a measurement indicative of an inclination and azimuth of said
3 borehole comprises a gyroscope.

4

1 43. (previously presented) The method of claim 20 wherein said directionally
2 sensitive formation evaluation sensor is selected from the group consisting of (i)
3 a resistivity sensor, and, (ii) a nuclear sensor.

4

1 44. (previously presented) The apparatus of claim 20 wherein said local spatial
2 characteristic of said earth formation is selected from the group consisting of (i) a
3 dip of an interface in said earth formation, and, (ii) an image of a wall of said
4 borehole.

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1 45. canceled

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46. (currently amended) The method of ~~claim~~ claim 20 further comprising altering a
direction of drilling of said BHA based at least in part on said estimated local
spatial characteristic of said earth formation.

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